FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Water Resource Management, Bureau of Watershed Management

SOUTHWEST DISTRICT • TAMPA BAY TRIBUTARIES BASIN

TMDL Report

Fecal Coliform TMDL for Gap Creek (WBID 1899)

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Florida Department of Environmental Protection, Bureau of Watershed Management

TMDL Program

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STORET Program

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Basin Status Report for the Tampa Bay Tributaries Basin

http://www.dep.state.fl.us/water/tmdl/stat_rep.htm

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U.S. Environmental Protection Agency

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Chapter 1: INTRODUCTION

1.1 Purpose of Report

This report presents the Total Maximum Daily Load (TMDL) for fecal coliform for Gap Creek in the Manatee River watershed, within the Tampa Bay Tributaries Basin. The stream was verified as impaired for fecal coliform, and was included on the Verified List of impaired waters for the Tampa Bay Tributaries Basin that was adopted by Secretarial Order on May 27, 2004. Gap Creek is located in the southwest corner of Manatee County and flows into the Braden River, which drains to the Manatee River **(Figure 1.1).** The TMDL establishes the allowable loadings to Gap Creek that would restore the waterbody so that it meets its applicable water quality criteria for fecal coliform.

1.2 Identification of Waterbody

Gap Creek is a second-order stream located in the southwest corner of Manatee County. It flows in a southwest-to-northeast direction into the Braden River (which in turn discharges to the Manatee River), and drains a watershed area of about 8.2 square miles **(Figure 1.1).** The river is about 6.4 miles long (including Pearce Canal, which comprises the southern portion of Gap Creek) and is flanked by the city of Bradenton to the north and city of Sarasota to the south. The watershed is part of the Gulf Coastal Lowland area, which has a relatively low relief and abundant karst features. Interactions between surface water and ground water in the region are common. Additional information about the river's hydrology and geology is available in the Basin Status Report for the Tampa Bay Basin (Florida Department of Environmental Protection, November 2001).

For assessment purposes, the Department has divided the Manatee watershed into water assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or stream reach**,** and this TMDL addresses the following WBID:

WBID 1899, Gap Creek – for fecal coliform

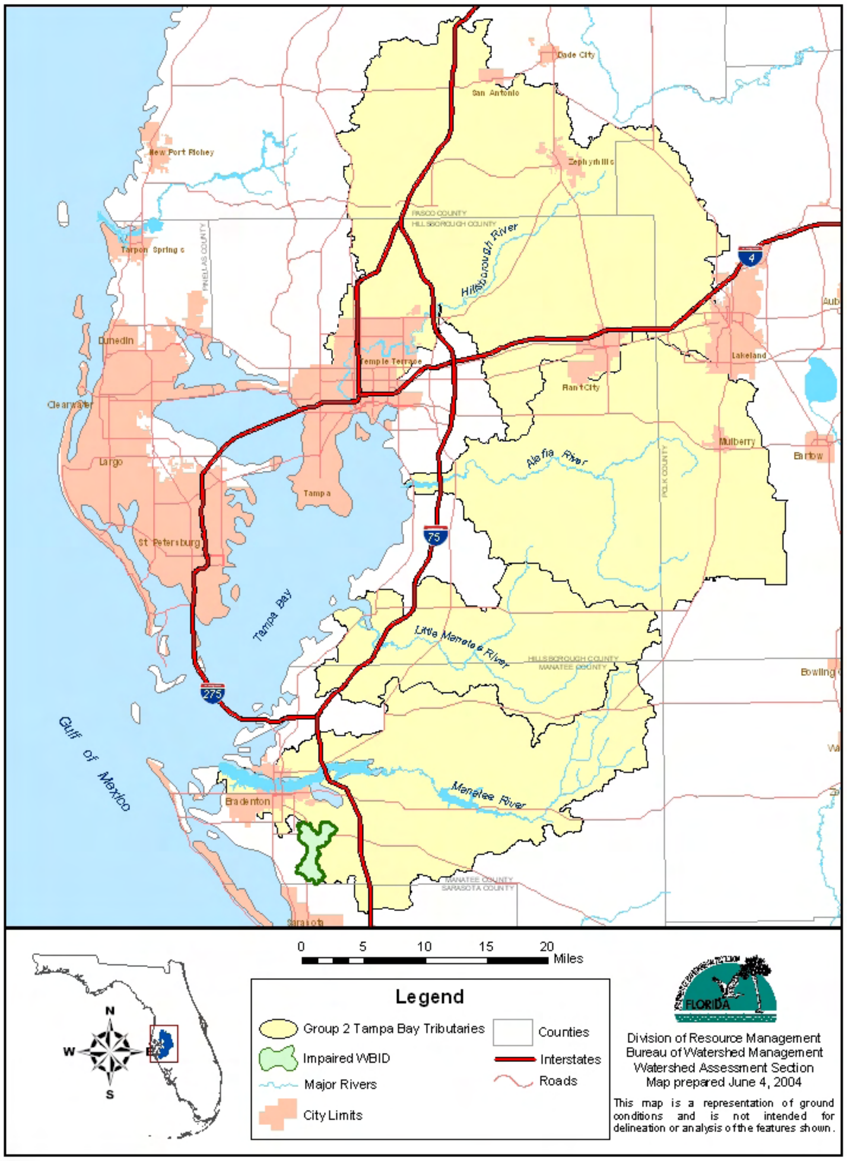
1.3 Background

This report was developed as part of the Florida Department of Environmental Protection's (Department) watershed management approach for restoring and protecting state waters and addressing TMDL Program requirements. The watershed approach, which is implemented using a cyclical management process that rotates through the state's 52 river basins over a 5-year cycle, provides a framework for implementing the TMDL Program–related requirements of the 1972 federal Clean Water Act and the 1999 Florida Watershed Restoration Act (FWRA, Chapter 99-223, Laws of Florida).

A TMDL represents the maximum amount of a given pollutant that a waterbody can assimilate and still meet water quality standards, including its applicable water quality criteria and its designated uses. TMDLs are developed for waterbodies that are verified as not meeting their water quality standards. TMDLs provide important water quality restoration goals that will guide restoration activities.

This TMDL Report will be followed by the development and implementation of a Basin Management Action Plan, or BMAP, to reduce the amount of fecal coliform that caused the verified impairment of Gap Creek. These activities will depend heavily on the active participation of the Southwest Florida Water Management District (SWFWMD), local governments, businesses, and other stakeholders. The Department will work with these organizations and individuals to undertake or continue reductions in the discharge of pollutants and achieve the established TMDLs for impaired waterbodies.

Figure 1.1: Location of Gap Creek and Major Geopolitical Features in the



Chapter 2: DESCRIPTION OF WATER QUALITY PROBLEM

2.1 Statutory Requirements and Rulemaking History

Section 303(d) of the federal Clean Water Act requires states to submit to the U.S. Environmental Protection Agency (EPA) a list of surface waters that do not meet applicable water quality standards (impaired waters) and establish a TMDL for each pollutant source in each of these impaired waters on a schedule. The Department has developed such lists, commonly referred to as 303(d) lists, since 1992. The list of impaired waters in each basin, referred to as the Verified List, is also required by the FWRA (Subsection 403.067[4)], Florida Statutes [F.S.]). Florida's 1998 303(d) list included 10 waterbodies in the Manatee watershed; the state's 303(d) list is amended annually to include basin updates.

However, the FWRA (Section 403.067, F.S.) stated that all previous Florida 303(d) lists were for planning purposes only and directed the Department to develop, and adopt by rule, a new science-based methodology to identify impaired waters. After a long rule-making process, the Environmental Regulation Commission adopted the new methodology as Chapter 62-303, Florida Administrative Code (F.A.C.) (Identification of Impaired Surface Waters Rule, or IWR), in April 2001.

2.2 Information on Verified Impairment

The Department used the IWR to assess water quality impairments in Gap Creek and has verified that the stream is only impaired for fecal coliform bacteria **(Table 2.1).** The impairment verification was based on the observation that 6 out of 20 samples collected during the verification period (January 1, 1996 – June 30, 2003) violated water quality criteria. This TMDL represents the assimilative capacity of Gap Creek for fecal coliform. **Table 2.2** provides the detailed monitoring results for fecal coliform for the verified period. As shown in table 2.1, the projected year for both fecal coliform and total coliform bacteria TMDLs were 2003, but the Settlement Agreement between EPA and Earthjustice, which drives the TMDL development schedule for waters on the 1998 303(d) list, allows an additional nine months to complete the TMDLs. As such, this TMDL must be adopted and submitted to EPA by September 30, 2004

Table 2.1. Verified Impairment for Gap Creek, WBID 1899

Parameter of Concern	Priority for TMDL Development	Projected Year for TMDL Development
Fecal coliform	High	2003

Table 2.2. Summary of Fecal Coliform Monitoring Data for Gap Creek, WBID 1899, by Water Quality Monitoring Station, in 1998 and 2002

Station ID	Year	Month	Day	Time	Results (MPN/100 mL)*
21FLTPA 24010070	1998	9	30	1200	**1,060**
21FLTPA 24010070	2002	3	27	1145	380
21FLTPA 272629228231033	2002	3	27	1220	**1,200**
21FLTPA 272649568230586	2002	3	27	130	380
21FLTPA 24010070	2002	4	10	1100	140
21FLTPA 272629228231033	2002	4	10	1020	205
21FLTPA 272649568230586	2002	4	10	1000	300
21FLTPA 24010070	2002	5	22	915	360
21FLTPA 272637868230409	2002	5	22	925	**420**
21FLTPA 272646068230395	2002	5	22	945	**640**
21FLTPA 272649568230586	2002	5	22	1000	**790**
21FLTPA 24010070	2002	9	11	1025	260
21FLTPA 272646068230395	2002	9	11	1055	**5,100**
21FLTPA 272649568230586	2002	9	11	1040	1
21FLTPA 24010070	2002	10	14	1140	270
21FLTPA 272646068230395	2002	10	14	1125	180
21FLTPA 272649568230586	2002	10	14	1110	5
21FLTPA 24010070	2002	11	4	1100	120
21FLTPA 272646068230395	2002	11	4	1045	200
21FLTPA 272649568230586	2002	11	4	1035	100

* Most probable number per 100 milliliters.
Note: Bold numbers represent the measurements that exceeded water quality criteria.

Chapter 3. DESCRIPTION OF APPLICABLE WATER QUALITY STANDARDS AND TARGETS

3.1 Classification of the Waterbody and Criteria Applicable to the TMDL

Florida's surface waters are protected for five designated use classifications, as follows:

Class I	**Potable water supplies**
Class II	**Shellfish propagation or harvesting**
Class III	**Recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife**
Class IV	**Agricultural water supplies**
Class V	**Navigation, utility, and industrial use (there are no state waters currently in this class)**

Gap Creek is a Class III waterbody, with a designated use of recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife.

3.2 Applicable Water Quality Standards and Numeric Water Quality Target

Fecal Coliform Criterion

Numeric criteria for bacterial quality are expressed in terms of fecal coliform bacteria concentrations. The water quality criterion for protection of Class III waters, as established by Chapter 62-302, F.A.C., states the following:

> ***Fecal Coliform Bacteria:***
> *The most probable number (MPN) or membrane filter (MF) counts per 100 ml of fecal coliform bacteria shall not exceed a monthly average of 200, nor exceed 400 in 10 percent of the samples, nor exceed 800 on any one day.*

The criterion further states that monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30-day period.

During the development of load duration curves for the impaired stream (as described in subsequent chapters), there were insufficient data (fewer than 10 samples in a given month) available to evaluate the geometric mean criterion for either fecal coliform or total coliform bacteria. Therefore, the criterion selected for the TMDLs was not to exceed 400 in any sampling event. The 10 percent exceedance allowed by the water quality criterion was not used directly in estimating the target load, but was included in the TMDL margin of safety (as described in subsequent chapters).

Chapter 4: ASSESSMENT OF SOURCES

4.1 Types of Sources

An important part of the TMDL analysis is the identification of pollutant source categories, source subcategories, or individual sources of pollutants in the Gap Creek watershed and the amount of pollutant loading contributed by each of these sources. Sources are broadly classified as either “point sources” or “nonpoint sources.” Historically, the term point sources has meant discharges to surface waters that typically have a continuous flow via a discernable, confined, and discrete conveyance, such as a pipe. Domestic and industrial wastewater treatment facilities (WWTFs) are examples of traditional point sources. In contrast, the term “nonpoint sources” was used to describe intermittent, rainfall driven, diffuse sources of pollution associated with everyday human activities, including runoff from urban land uses, agriculture, silviculture, and mining; discharges from failing septic systems; and atmospheric deposition.

However, the 1987 amendments to the Clean Water Act redefined certain nonpoint sources of pollution as point sources subject to regulation under the EPA’s National Pollutant Discharge Elimination (NPDES) Program. These nonpoint sources included certain urban stormwater discharges, including those from local government master drainage systems, construction sites over five acres, and a wide variety of industries (see **Appendix A** for background information on the federal and state stormwater programs).

To be consistent with Clean Water Act definitions, the term “point source” will be used to describe traditional point sources (such as domestic and industrial wastewater discharges) and stormwater systems requiring an NPDES stormwater permit when allocating pollutant load reductions required by a TMDL (see **Section 6.1**). However, the methodologies used to estimate nonpoint source loads do not distinguish between NPDES stormwater discharges and non-NPDES stormwater discharges, and as such, this source assessment section does not make any distinction between the two types of stormwater.

4.2 Potential Sources of Fecal Coliform in the Gap Creek Watershed

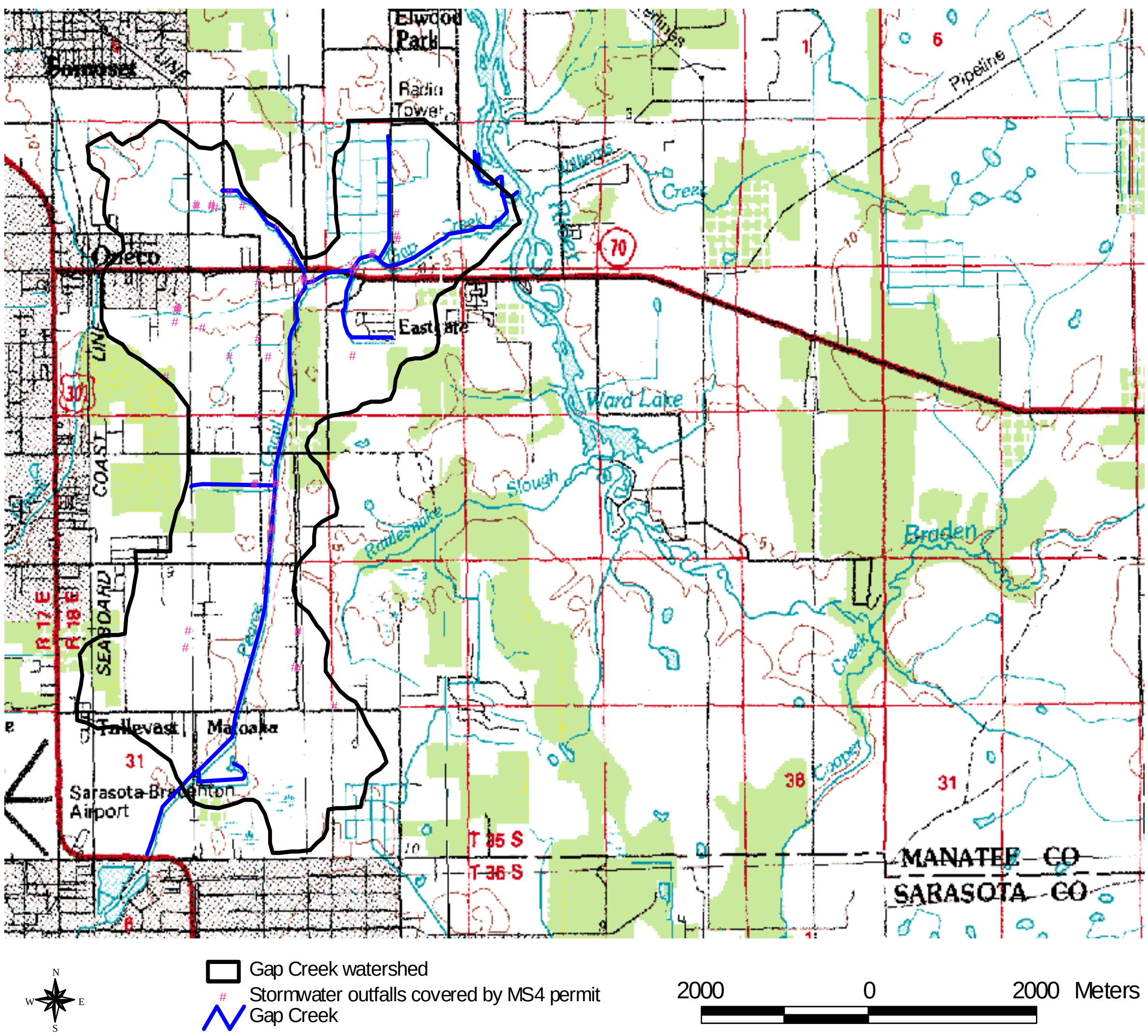
4.2.1 Point Sources

Two permitted facilities were identified in the Gap Creek watershed. The Ringhaver Equipment Company (Permit Number FLA012650), an equipment rental and leasing company, totally recycles its wastewater (the permit was issued in 1996) and has no surface discharges. Another facility, the Kerr Food and Beverage Group, is under both a multisector general stormwater permit (FLR05F533) and an industrial wastewater permit (FL0372943). While the stormwater permit was issued in 2002, the facility applied for the wastewater permit in June 2004. The nature of the wastewater from the facility is still unknown. However, because the facility produces injected molded closures for the food and beverage industry, it is not expected to discharge wastewater with a high fecal coliform load. Therefore, for the Gap Creek watershed, no major point source was identified as discharging fecal coliform into surface water.

Municipal Separate Storm Sewer System Permittees

Phase I or Phase II MS4s. In the Manatee watershed, the stormwater collection systems owned and operated by Manatee County and FDOT are covered by an NPDES municipal separate storm sewer system (MS4) permit. Manatee County and FDOT are copermittees for the basin, but Manatee County is the lead permittee for the Gap Creek watershed. Several other local governments in the watershed have also applied for coverage under the Phase II NPDES MS4 permits. However, the area covered by those permits is beyond the boundary of the Gap Creek watershed. **Figure 4.1** shows the outfalls of the stormwater system in the Gap Creek watershed.

Figure 4.1. Stormwater Outfalls Covered by MS4 Permits in the Gap Creek Watershed



4.2.2 Land Uses and Nonpoint Sources

Nonpoint Sources

Because no major point source was identified in the Gap Creek watershed, it is reasonable to believe that the primary loadings of fecal coliform to the creek are generated from nonpoint sources in the watershed. Nonpoint sources of coliform bacteria generally, but not always, come from the accumulation of coliform bacteria on land surfaces that washes off as a result of storm events, and the ground water contribution from sources such as failed septic tanks and the improper land application of domestic wastewater residuals. Typical nonpoint sources of coliform bacteria include the following:

- Wildlife,
- Agricultural animals,
- Pets in residential areas,
- Onsite sewage treatment and disposal systems (septic tanks),
- Land application of domestic wastewater residuals, and
- Urban development (outside of Phase I or II MS4 discharges).

The load duration curve analysis described in detail in later chapters sheds some light on possible nonpoint sources of fecal coliform in the Gap Creek watershed. According to **Figure 5.2** (in Chapter 5), most of the fecal coliform exceedances occurred in several flow duration zones: moist, dry, and low-flow conditions. However, one of the exceedances in the moist flow duration zone was identified in 1998 at Site 21FLTPA 24010070. This was the only sample collected in 1998 **(Table 2.2).** The rest of the data used in this report were all collected in 2002.

Based on communication with the Manatee County Environmental Management Department, land use in the Gap Creek watershed changed significantly between 1998 and 2002, and mixing a single 1998 sampling result with 19 data points from 2002 in the TMDL analysis may not be appropriate. Therefore, the 1998 data point was not considered in developing the TMDL.

Another exceedance in the moist flow duration zone was found in September 11, 2002, at Station 21FLTPA 272646068230395, when the fecal coliform count was 5,100 MPN/100mL **(Table 2.2).** In the meantime, fecal coliform concentrations at Site 21FLTPA 272649568230586, which is about 400 meters upstream of Site 21FLTPA 272646068230395, was only 1 MPN/100 mL. At Site 21FLTPA 24010070, which is only about 700 meters downstream of Site 21FLTPA 272646068230395, a fecal coliform concentration of about 260 MPN/100 mL was observed. The low fecal coliform counts observed at the surrounding sites make the 5,100 MPN/100 mL at Site 21FLTPA 272646068230395 suspect. Because no other information could be used to confirm the high exceedance at Site 21FLTPA 272646068230395, this data point was also removed.

All the other exceedances were observed in the dry to low-flow condition **(Figure 5.2)** after the removal of the two data points discussed above. Because no major point source was identified that discharges fecal coliform into Gap Creek, an exceedance under dry weather conditions could be considered as stemming primarily from baseflow, which carries the pollutant from the surficial aquifer. This is consistent with the fact that Gap Creek is deeply incised, and some portions of it are more than 10 feet deep (Manatee County, 1982).

Baseflow pollution could result from many different sources, including failed septic tanks. However, according to both the Department's Southwest District Office and the Manatee County Environmental Management Department, septic tank failure may not be a significant source of fecal coliform bacteria in the Gap Creek watershed, because most of the newly built subdivisions are connected to the city sewer system. The 1999 geographic information system (GIS) land use coverage of the watershed also shows that while the urban and residential area accounts for about 57 percent of the total watershed, the low-density residential area, which likely is still on septic tanks, only accounts for about 7 percent of the total watershed. Only a relatively small portion of the low-density residential area is actually located along the stream. This is consistent with observations from the Department's District Office and Manatee County.

Leaking sewer systems could be a potential source of fecal coliform in Gap Creek. Another possible source, according to the Manatee County Environmental Management Department, is irrigation water from residential lawns along the stream. The irrigation water could carry fecal coliform from pet feces into surficial ground water, or an irrigation system could even discharge directly into the stream if it is improperly constructed.

Wildlife could also contribute to the fecal coliform exceedances in Gap Creek. Communication with the Manatee County Environmental Management Department and a photograph provided by the Southwest District Office indicates that the banks of Gap Creek are reasonably well vegetated and provide habitats for wild animals such as birds, raccoons, bobcats, rabbits, and occasionally, deer. These animals have direct access to the stream, especially under low-flow conditions. **Figure 4.2** shows significant amounts of vegetative cover along a portion of Gap Creek, upstream from one of the sampling sites.

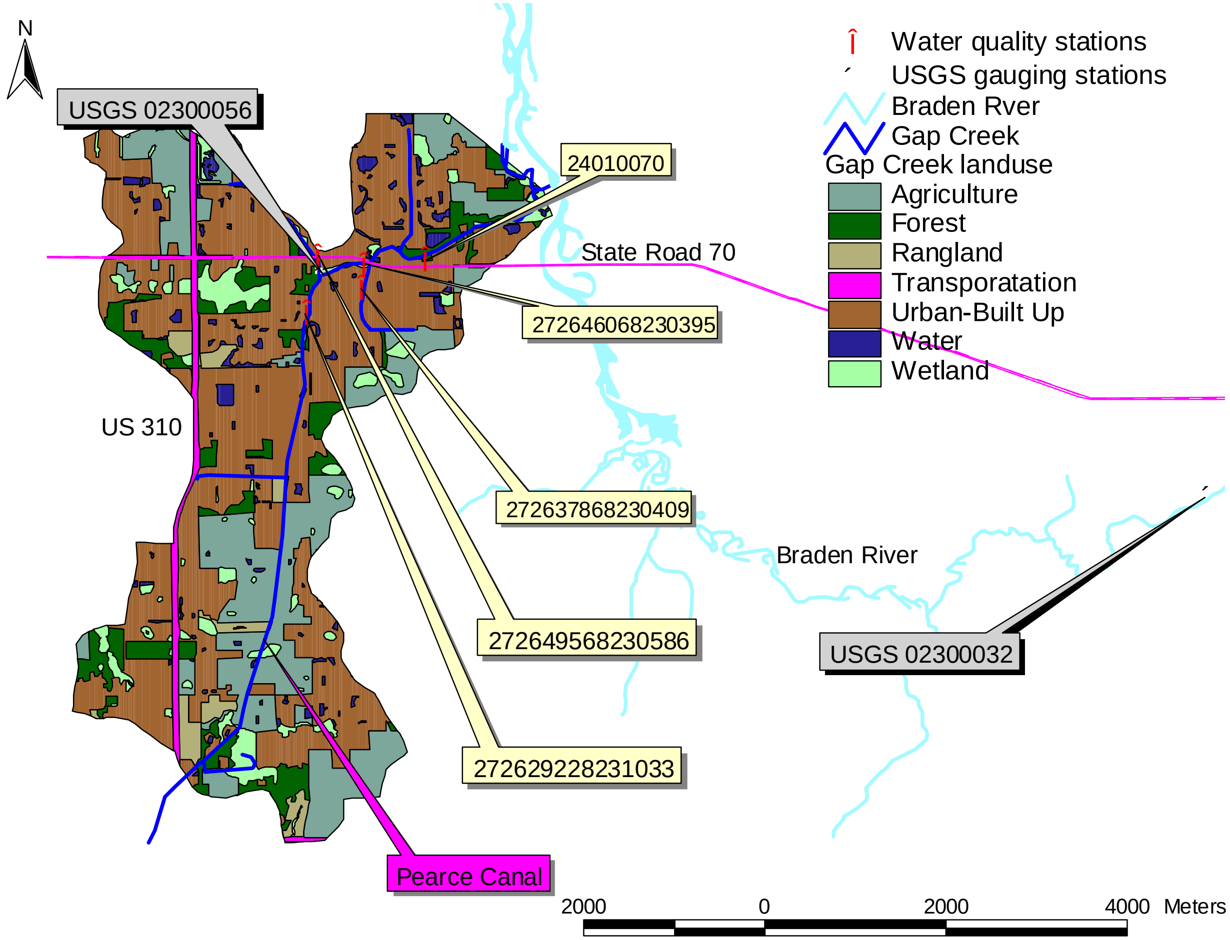
Whether livestock operations in the Gap Creek watershed are a significant source of fecal coliform or not remains unknown. Pearce Canal, which comprises the southern part of Gap Creek, drains a large area in agriculture and pastureland **(Figure 4.3).** Theoretically, livestock operations could be a significant source for Gap Creek in the area where the water samples were collected. However, a field reconnaissance found no heavy livestock operations along Pearce Canal.

In addition, based on the Flood Profile Chart reported in a Flood Insurance Study by Manatee County (Manatee County, 1982), there are several pool structures along Pearce Canal. Fecal coliform from the Pearce Canal agricultural land and pastureland under dry, low-flow conditions could be retained by these pool structures and remain localized in Pearce Canal, instead of being transported to Gap Creek. Fecal coliform retained in these pool structures could be resuspended and transported downstream during high-flow events. However, as the load duration curve analysis discussed in Chapter 5 indicates, except for the two discarded data points, all the other exceedances appeared under low-flow conditions, when the contribution from Pearce Canal should be minimal. In fact, the only data point collected at Station 21FLTPA 272629228231033, which could reflect the influence from the Pearce Canal area, did not exceed water quality criteria.

In summary, the data set is not large enough to assess the nonpoint sources of fecal coliform with great certainty. While sources such as leaking sewer lines, lawn irrigation, and wildlife could be important contributors to the exceedances in the creek, more comprehensive studies need to be conducted to pinpoint the major contributor(s) of fecal coliforms in the Gap Creek watershed.

Figure 4.2. Vegetation Covering Gap Creek (looking upstream from Site 21FLTPA 272646068230395)

Figure 4.3. Principal Land Uses in the Gap Creek Watershed and the Locations of USGS Gaging Stations and Water Quality Monitoring Stations



Land Uses

The spatial distribution and acreage of different land use categories in the watershed were identified using the SWFWMD's land use coverage (scale 1:40,000) contained in the Department's GIS library. Land use categories were aggregated using the simplified Level 1 codes tabulated in **Table 4.1.** **Figure 4.3** shows the principal land uses in the watershed.

The Gap Creek watershed drains about 5,247 acres into Gap Creek. The dominant land use category is urban and built-up, including low-, medium-, and high-density residential areas and transportation, communication, and utilities. Urban and built-up land uses cover about 2,989 acres and account for about 57 percent of the watershed's total area. Agriculture and rangeland claim another 25 percent of the watershed. Natural land uses, which include the upland forest, water, and wetland categories, account for about 18 percent of the total watershed area. Generally, the watershed is highly urbanized, and human activities are the dominant factor controlling the local hydrology. **Table 4.1** lists the acreage of each land use category in the watershed.

Table 4.1. Classification of Land Use Categories in the Gap Creek Watershed

Code	Land Use	Acreage
1000	Urban open	1,348
	Low-density residential	373
	Medium-density residential	221
	High-density residential	917
2000	Agriculture	1,162
3000	Rangeland	140
8000	Transportation, communication, and utilities	129
4000	Forest/rural open	450
5000/6000	Water/wetland	507
	TOTAL	**5,247**

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Determination of Loading Capacity

The methodology used for this TMDL is the load duration curve. Also known as the “Kansas Approach,” because it was developed by the state of Kansas, this method has been well documented in the literature, with improved modifications used by EPA Region 4. Basically, the method relates the pollutant concentration to the flow of the stream to establish the existing loading capacity and the allowable pollutant load (TMDL) under a spectrum of flow conditions, and determines the maximum allowable pollutant load and load reduction requirement based on the analysis of the critical flow conditions. Using this method, it takes four steps to develop the TMDL and establish the required load reduction, as follows:

1. Develop the flow duration curve,
2. Develop the load duration curve for both the allowable load and existing loading capacity,
3. Define the critical conditions, and
4. Establish the needed load reduction by comparing the existing loading capacity with the allowable load under critical conditions.

5.1.1 Data Used in the Determination of the TMDL

Fecal coliform concentrations and flow measurements were required to estimate both the allowable pollutant load and existing loading capacity. **Figure 4.3** shows the locations of the water quality sites from which fecal coliform data were collected and the USGS gaging station from which the flow measurements were taken. In total, 20 fecal coliform samples were collected from 5 sites. Except for 1 measurement taken in 1998, the remaining 19 measurements were taken in each quarter of 2002 to meet the data requirements for the assessment threshold for the verified period. The Department’s Southwest District Office provided all the fecal coliform data used in this report.

Because these sampling sites were relatively close to each other, and also because only a limited number of measurements were available for each site, fecal coliform measurements from all the sites were combined and treated as though they were from the main stem site. Two fecal coliform counts that appeared in the moist flow duration zone were not considered in developing the final TMDL, due to the reasons discussed earlier. Only the flow measurements from the main channel were applied to these fecal coliform measurements. Applying the main channel flow measurements to fecal coliform measurements in the tributary could overestimate the fecal coliform load. However, this approach was taken because of the lack of fecal coliform measurements in the main channel, and also because this approach made the TMDL more conservative and therefore increased the margin of safety.

Table 5.1 shows the statistical summary for the fecal coliform measurement. No historical data were available for this report.

Table 5.1. Statistical Table of Observed Data for Fecal Coliform in Gap Creek, WBID 1899*

Total Number of Samples	30-Day Geometric Mean	Number of Samples >400 MPN/100mL	Minimum Concentration (MPN/100mL)	Maximum Concentration (MPN/100mL)
18	N/A	4	1	1,200

N/A = Not applicable.

The flow measurements from the USGS gaging station (USGS 02300056: Gap Creek near Bradenton, Florida, Latitude: 27^{0}26'42", Longitude: 82^{0}30'57) were used in this report. Because the flow measurements from the station only covered the period from July 1, 1995, through September 30, 1997, which did not match up with the period when the water quality samples were collected, measurements from another USGS gaging station (USGS 02300032) were used to extend the flow data from USGS 02300056 using the "Move. 1" statistical routine (discussed in detail in the following section). The flow duration curve for Gap Creek was developed based on a mixed flow data set, which includes both measured data when they were available, and the "Move. 1" estimated data when the measured data were not available. **Figure 4.3** shows the locations of the two USGS gaging stations.

5.1.2 TMDL Development Process

Develop the Flow Duration Curve

The first step in the development of load duration curves is to create *flow duration curves*. A flow duration curve displays the cumulative frequency distribution of daily flow data over the period of record. The duration curve relates flow values measured at a monitoring station to the percent of time the flow values were equalled or exceeded. Flows are ranked from low, which are exceeded nearly 100 percent of the time, to high, which are exceeded less than 1 percent of the time.

The flow data set from the Gap Creek gaging station was extrapolated using the "Move.1" statistical routine (Hirsch, 1982) based on the flow measurement collected from a nearby gaging station on the Braden River (USGS 02300032). This station's flow record covers the period from July 1, 1995, through September 30, 2003. "Move.1" extends the flow data set using the following equation:

$$Y = mean(Y) + \frac{stdev(Y)}{stdev(X)} * (X - mean(X)) \qquad \textbf{(1)}$$

Where:

- Y is the simulated daily flow for Gap Creek,
- Mean (Y) is the average logarithmic daily flow over the period of record for Gap Creek,
- Stdev (Y) is the standard deviation of the daily flow over the period of record for Gap Creek,
- X is the measured daily flow for the Braden River,
- Mean (X) is the average logarithmic daily flow over the period of record for the Braden River, and
- Stdev (X) is the standard deviation of the daily flow over the period of record for the Braden River.

Table 5.2 lists the means and standard deviations of the logarithmic flow measurements for Gap Creek and the Braden River. Means and standard deviations for both waterbodies were calculated based on the flow measurements taken between July 1, 1996, and September 30, 1997, the period when both flow stations had flow measurements.

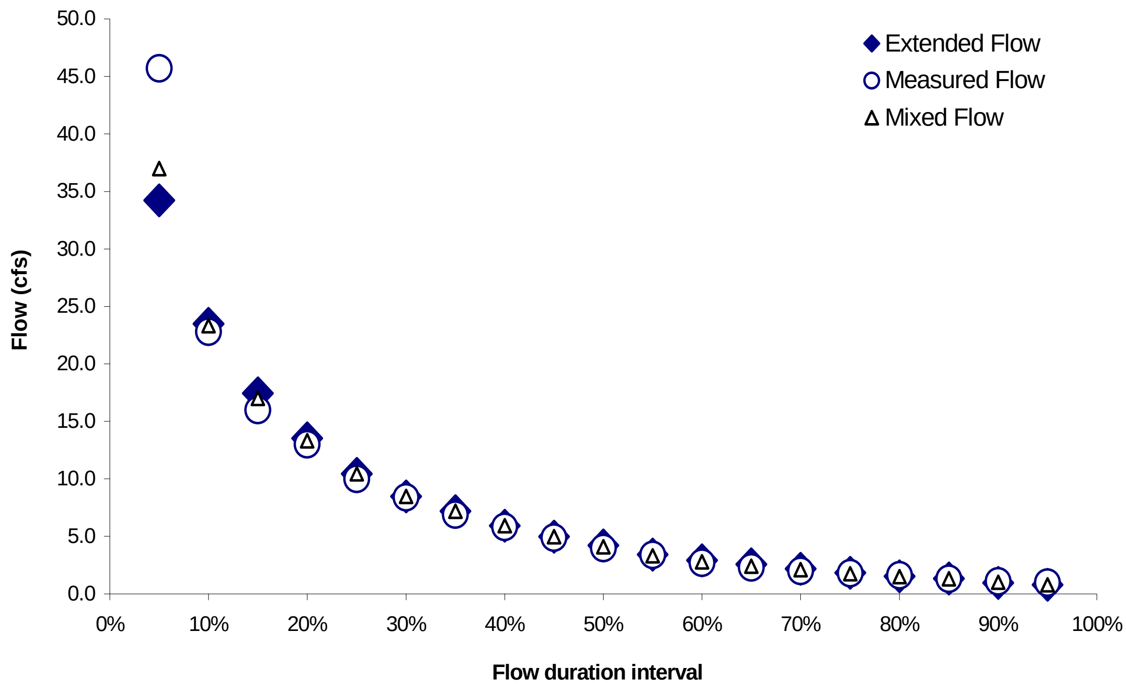
Table 5.2. Means and Standard Deviations of the Logarithmic Flow Measurements for Gap Creek (Y) and the Braden River (X)

	Log Braden River Flow (X)	Log Gap Creek flow (Y)
Mean	0.4547	0.4981
Stdev	0.9236	0.5307
$\frac{stdev(Y)}{stdev(X)}$	0.575	

The flow duration curve for the TMDL was created by using the percentile function and the flow record to generate the flow at a given duration interval. For example, at the 90th duration interval, the percentile function calculates the flow that is equal or exceeded 90 percent of the time. **Figure 5.1** shows the flow duration curves for Gap Creek generated from the measured flow and the estimated flow using “Move. 1.” Flows toward the right side of the plot are flows exceeded in greater frequency and are indicative of low-flow conditions. Flows on the left side of the plot represent high flows and occur less frequently.

To make sure that the final flow data set was as close to reality as possible, measured flow was used whenever there was a measured record. This created a mixed data set that includes both the “Move. 1” predicted flow and measured flow. **Figure 5.1** demonstrates that the flow duration curves based on measured, extended, and mixed data sets are very similar. In creating the load duration curves in this report, the flow duration interval based on the mixed data set was used.

Figure 5.1. Flow Duration Curve for Gap Creek, WBID 1899



Develop the Load Duration Curves for Both the Allowable Load and Existing Loading Capacity

Flow duration curves are transformed into load duration curves by multiplying the flow values along the flow duration curve by the coliform concentration and the appropriate conversion factors. The final result of the load is typically expressed as MPN per day. The following equations were used to calculate the allowable loads and the existing loading capacities:

Allowable load = (observed flow) x (conversion factor) x (state criteria) (2)

Existing loading capacities = (observed flow) x (conversion factor) x (fecal coliform measurement) (3)

On the load duration curve, allowable and existing loads are plotted against the flow duration ranking. The allowable load is based on the water quality numeric criterion and flow values from the flow duration curve, and the line drawn through the data points representing the allowable load is called the target line. The existing loads are based on the instream fecal coliform concentrations measured during ambient monitoring and an estimate of flow in the stream at the time of sampling. As noted previously, because insufficient data were collected to evaluate the fecal coliform geometric mean, 400 counts/100mL was used as the target criterion in this TMDL. **Figure 5.2** shows both the allowable load and the existing load over the flow duration ranking for Gap Creek. The points of the existing loading capacities that were higher than the allowable load at a given flow duration ranking were considered an exceedance of the criterion.

As shown in **Figure 5.2**, the exceedance of fecal coliform bacteria in Gap Creek mostly appeared under the low-flow condition. In general, exceedances on the right side of the curve typically occur during low-flow events, implying a contribution from either point sources or baseflow. Because no major point source was identified in the Gap Creek watershed, the exceedance under the low-flow condition implies a contribution from baseflow. As discussed earlier, this could result from leaking sewer lines, lawn irrigation, and wild animals.

Define the Critical Condition

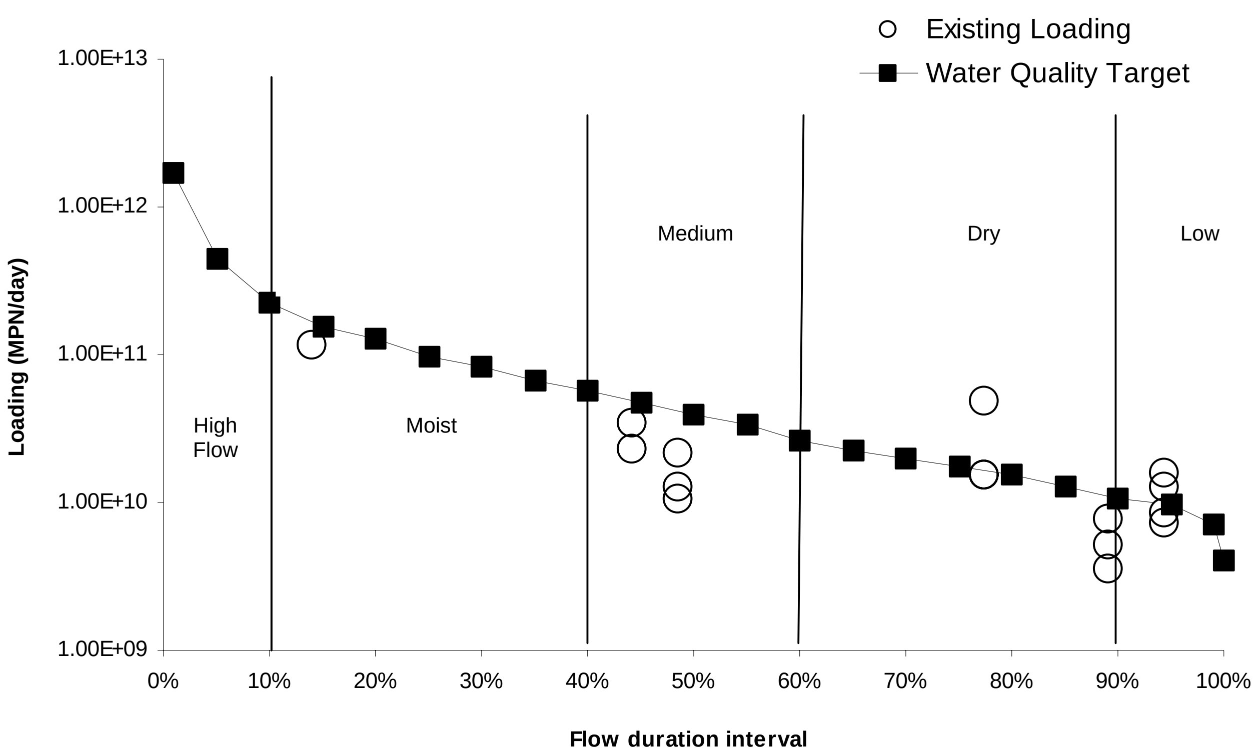
What constitutes the critical condition for coliform loadings in a given watershed depends on the existence of point sources and land use patterns in the watershed. Typically, the critical condition for nonpoint sources is an extended dry period followed by a rainfall runoff event. During wet weather, rainfall washes coliform bacteria accumulated on the land surface during dry weather into surface water, resulting in the wet weather exceedance. However, significant nonpoint source contributions could also appear under the dry weather condition without any major surface runoff event. This usually happens when nonpoint sources contaminate the surficial aquifer, and baseflow carries fecal coliform bacteria into the receiving waters. In addition, as described earlier, livestock with direct access to the receiving water could also contribute to the exceedance during dry weather conditions. The critical condition for point source loading typically occurs during periods of low stream flow, when dilution is minimized.

To characterize the critical condition, the entire flow duration was divided into the following intervals:

1. High (0 to 10 percent)
2. Moist (10 to 40 percent)
3. Medium (40 to 60 percent)
4. Dry (60 to 90 percent)
5. Low (90 to 100 percent)

For the Gap Creek watershed, observed exceedances primarily occurred under moist, dry, and low-flow conditions. Due to the reasons discussed earlier **(Section 4.2.2),** measured exceedances that appeared under the moist condition were not used in developing this TMDL. Therefore, exceedances of fecal coliforms in Gap Creek mainly appeared under the dry–low flow conditions. Because no major point source was identified in the watershed, exceedances in these flow duration intervals were considered to be from nonpoint sources. The critical condition is accounted for in the load curve analysis by using the flow records and water quality data available from the dry and low-flow intervals.

Figure 5.2: Load Duration Curves for the Allowable Load and Existing Loading Capacity for Gap Creek, WBID 1899*



* Due to the reasons discussed in **Section 4.2.2,** the two exceedances observed in the moist flow duration zone were not used in developing the TMDL.

Establish the Needed Load Reduction by Comparing the Existing Loading Capacity with the Allowable Load under the Critical Condition

The fecal coliform load reduction required to achieve the water quality criterion was established by comparing the existing loading capacity with the allowable load under the critical conditions defined in the previous section. The actual needed load reduction was calculated using the following equation:

$$load\_reduction = \frac{Existing\_Loading - Allowable\_loading}{Existing\_loading} \times 100\% \qquad \textbf{(4)}$$

Where:

- The *Existing_loading* was calculated as the product of the measured fecal coliform concentration and the flow value associated with the coliform measurement (The *Existing loading* was only calculated for sampling events for which the fecal coliform concentration exceeded the 400counts/100 ml criteria), and
- The *Allowable_loading* was calculated as the product of the water quality criterion (400 counts/100ml) and the flow. *Allowable_loadings* were first calculated for the flow duration from the 60^{th} to 100^{th} percentile, with 5 percent flow ranking increments. The median value of these *Allowable_loading*s was considered the TMDL for this study. *Allowable_loading*s were then calculated at the corresponding flow for each coliform sample above the criteria so that paired *Existing loading* and *Allowable_loading* could be used to calculate the *percent load reduction* needed for each coliform sample above the criteria.

Table 5.3 lists the flow duration intervals, the *Allowable_loading*, *Existing_loading* capacity, and the needed percent load reduction to achieve the *Allowable_loading* in the dry and low flow zone (60^{th} – 100^{th} percentile flow duration). The table includes the median percent reduction for the four cases where the samples exceeded the criteria, which represents the overall percent reduction needed for the creek to meet the criteria over the critical conditions.

Table 5.3. Allowable Loads, Existing Loading Capacities, and Needed Load Reduction for the Critical Flow Condition

Flow Duration Interval	Flow Ranking at 5 percent increment	Allowable Load corresponding to 5% flow increment (counts/day)	Flow Ranking at measured flow	Allowable Loading at measured flow (Counts/day)	Existing Loading at measured flow (Counts/day)	Percent load reduction
Dry	65.0%	2.25E+10	77%	4.95E+10	1.649E+10	66.7%
	70.0%	1.96E+10				
	75.0%	1.76E+10				
	80.0%	1.57E+10				
	85.0%	1.27E+10				
	90.0%	1.08E+10				
Low	95.0%	9.69E+09	94%	8.124E+09	8.53E+09	4.8%
			94%	8.124E+09	1.30E+10	37.5%
	100.0%	7.14E+09	94%	8.124E+09	1.60E+10	49.4%
Median		**1.37E + 10**				**43.3%**

Chapter 6: DETERMINATION OF THE TMDL

6.1 Expression and Allocation of the TMDL

The objective of a TMDL is to provide a basis for allocating acceptable loads among all of the known pollutant sources in a watershed so that appropriate control measures can be implemented and water quality standards achieved. A TMDL is expressed as the sum of all point source loads (Waste Load Allocations, or WLAs), nonpoint source loads (Load Allocations, or LAs), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$\mathbf{TMDL = \sum WLAs + \sum LAs + MOS}$$

As discussed earlier, the WLA is broken out into separate subcategories for wastewater discharges and stormwater discharges regulated under the NPDES Program:

$$\mathbf{TMDL \cong \sum WLAs_{wastewater} + \sum WLAs_{NPDES\ Stormwater} + \sum LAs + MOS}$$

It should be noted that the various components of the revised TMDL equation may not sum up to the value of the TMDL because (a) the WLA for NPDES stormwater is typically based on the percent reduction needed for nonpoint sources and is also accounted for within the LA, and (b) TMDL components can be expressed in different terms (for example, the WLA for stormwater is typically expressed as a percent reduction, and the WLA for wastewater is typically expressed as mass per day).

WLAs for stormwater discharges are typically expressed as “percent reduction” because it is very difficult to quantify the loads from MS4s (given the numerous discharge points) and to distinguish loads from MS4s from other nonpoint sources (given the nature of stormwater transport). The permitting of stormwater discharges also differs from the permitting of most wastewater point sources. Because stormwater discharges cannot be centrally collected, monitored, and treated, they are not subject to the same types of effluent limitations as wastewater facilities, and instead are required to meet a performance standard of providing treatment to the “maximum extent practical” through the implementation of BMPs.

This approach is consistent with federal regulations (40 CFR § 130.2[I]), which state that TMDLs can be expressed in terms of mass per time (e.g., pounds per day), toxicity, or other appropriate measure. TMDLs for Gap Creek are expressed in terms of MPN/day and represent the maximum daily fecal coliform load the stream can assimilate and maintain the fecal coliform criterion **(Table 6.1).** The TMDL was calculated as the mean midpoint allowable loads of dry and low-flow duration intervals. Percent fecal coliform reduction was calculated as the average needed load reduction for the critical flow duration intervals **(Table 5.3).**

Table 6.1. TMDL Components for Fecal Coliform in Gap Creek, WBID 1899

TMDL (colonies/day)	WLA		LA (Percent Reduction)	MOS
	Wastewater (colonies/day)	NPDES Stormwater (percent)		
1.37E + 10	N/A	43.3%	43.3 %	Implicit

6.2 Load Allocation (LA)

Based on a loading duration curve approach similar to that developed by Kansas (Stiles, 2002), a total coliform reduction of 43.3 percent is needed from nonpoint sources. It should be noted that the LA includes loading from stormwater discharges regulated by the Department and the water management districts that are not part of the NPDES Stormwater Program (see **Appendix A**).

6.3 Wasteload Allocation (WLA)

6.3.1 NPDES Wastewater Discharges

No NPDES-permitted wastewater facilities with fecal coliform limits were identified in the Gap Creek watershed.

6.3.2 NPDES Stormwater Discharges

The WLA for stormwater discharges with an MS4 permit is a 43.3 percent reduction in current fecal coliform loading from the MS4. It should be noted that any MS4 permittee will only be responsible for reducing the loads associated with stormwater outfalls that it owns or otherwise has responsible control over, and it is not responsible for reducing other nonpoint source loads in its jurisdiction.

6.4 Margin of Safety

Consistent with the recommendations of the Allocation Technical Advisory Committee (Florida Department of Environmental Protection, February 2001), an implicit margin of safety (MOS) was assumed in the development of this TMDL. An implicit MOS was provided by the conservative decisions associated with a number of modeling assumptions and the determination of assimilative capacity. An implicit MOS was inherently incorporated by applying the main channel flow measurements to the water quality stations located in the tributary, and by using 400 MPN/100 mL of fecal coliform as the water quality target for each and every sampling event, instead of setting the criteria as no more than 10 percent of the samples exceeding 400 MPN/100 mL.

Chapter 7: NEXT STEPS: IMPLEMENTATION PLAN DEVELOPMENT AND BEYOND

7.1 Basin Management Action Plan

Following the adoption of this TMDL by rule, the next step in the TMDL process is to develop an implementation plan for the TMDL, which will be a component of the Basin Management Action Plan (BMAP) for Gap Creek, within the Tampa Bay Tributaries Basin. This document will be developed over the next year in cooperation with local stakeholders and will attempt to reach consensus on more detailed allocations and on how load reductions will be accomplished. The BMAP will include the following:

- Appropriate allocations among the affected parties,
- A description of the load reduction activities to be undertaken,
- Timetables for project implementation and completion,
- Funding mechanisms that may be utilized,
- Any applicable signed agreement,
- Local ordinances defining actions to be taken or prohibited,
- Local water quality standards, permits, or load limitation agreements, and
- Monitoring and follow-up measures.

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Appendices

Appendix A: Background Information on Federal and State Stormwater Programs

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of nonpoint source pollution by requiring new development and redevelopment to treat stormwater before it is discharged. The Stormwater Rule, as authorized in Chapter 403, F.S., was established as a technology-based program that relies on the implementation of BMPs that are designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Chapter 62-40, F.A.C.

The rule requires the state's water management districts to establish stormwater pollutant load reduction goals (PLRGs) and adopt them as part of a SWIM plan, other watershed plan, or rule. Stormwater PLRGs are a major component of the load allocation part of a TMDL. To date, stormwater PLRGs have been established for Tampa Bay, Lake Thonotosassa, the Winter Haven Chain of Lakes, the Everglades, Lake Okeechobee, and Lake Apopka. No PLRG has been developed for Newnans Lake at the time this TMDL report was developed.

In 1987, the U.S. Congress established Section 402(p) as part of the federal Clean Water Act Reauthorization. This section of the law amended the scope of the federal NPDES stormwater permitting program to designate certain stormwater discharges as "point sources" of pollution. These stormwater discharges include certain discharges that are associated with industrial activities designated by specific standard industrial classification (SIC) codes, construction sites disturbing 5 or more acres of land, and master drainage systems of local governments with a population above 100,000, which are better known as MS4s. However, because the master drainage systems of most local governments in Florida are interconnected, the EPA has implemented Phase I of the MS4 permitting program on a countywide basis, which brings in all cities (incorporated areas), Chapter 298 urban water control districts, and FDOT throughout the 15 counties meeting the population criteria.

An important difference between the federal and state stormwater permitting programs is that the federal program covers both new and existing discharges, while the state program focuses on new discharges. Additionally, Phase II of the NPDES Program will expand the need for these permits to construction sites between 1 and 5 acres, and to local governments with as few as 10,000 people. These revised rules require that these additional activities obtain permits by 2003. While these urban stormwater discharges are now technically referred to as "point sources" for the purpose of regulation, they are still diffuse sources of pollution that cannot be easily collected and treated by a central treatment facility similar to other point sources of pollution, such as domestic and industrial wastewater discharges. The Department recently accepted delegation from the EPA for the stormwater part of the NPDES Program. It should be noted that most MS4 permits issued in Florida include a re-opener clause that allows permit revisions to implement TMDLs once they are formally adopted by rule.

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